

# MONTHLY WEATHER REVIEW.

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No. 1.

## INTRODUCTION.

This REVIEW for January, 1894, is based on reports from 3,071 stations occupied by regular and voluntary observers. These reports are classified as follows: 154 reports from Weather Bureau stations; 41 reports from United States Army post surgeons; 2,162 monthly reports from state weather service and voluntary observers; 29 reports from Canadian stations; 220 reports through the Southern Pacific Railway Company; 429 marine reports through the co-operation of the Hydrographic Office, Navy Department, and "New York Herald Weather Service;" 36 weekly reports from 10 U. S.

Life-Saving stations; no reports from navigators on the Great Lakes; monthly reports from local services established in all states and territories; and international simultaneous observations. Trustworthy newspaper extracts and special reports have also been used.

The WEATHER REVIEW for this month has been prepared under the general editorial supervision of Prof. Cleveland Abbe. The statistical data is furnished by the Records Division, in charge of Mr. A. J. Henry, acting chief of that division.

## CHARACTERISTICS OF THE WEATHER FOR JANUARY, 1894.

### HIGH AREAS.

The most important area of high pressure was that which attended the cold wave of January 23-26; the highest pressures recorded in this connection were 31.24, at Calgary, Alberta, and 31.08 at Havre, Mont., on the 23d, a. m. The lowest temperatures recorded were -38, at Valentine, Nebr., and St. Vincent, Minn.; -36 at Williston, N. Dak., January 24, a. m., and -44 at White River, Ont., January 25, a. m.

### LOW AREAS.

The lowest pressures recorded during the month were 28.48, at Sidney, C. B. I., on the 13th, a. m.; 28.88, at Halifax, N. S., on the 12th, p. m.; 28.78, at Boston, Mass., on the 30th, a. m.;

28.78, at Eastport, Me., on the 30th, p. m.; 28.88, at Sydney, C. B. I., 31st, a. m. The storms attending these lows were the severest of the month.

### TEMPERATURE.

Temperatures were generally above the average throughout the United States, the only exceptions being Montana, the Dakotas, California, and Arizona.

### PRECIPITATION.

The total quantity of rain or melted snow was slightly below the average in the Gulf and Atlantic States, but above the average in northern California, Washington, Oregon, Idaho, Montana, Manitoba, the upper Lake region, and Ontario.

## ATMOSPHERIC PRESSURE.

[In inches and hundredths.]

The distribution of mean atmospheric pressure reduced to sea level for January, 1894, as determined from observations taken daily at 8 a. m. and 8 p. m. (seventy-fifth meridian time), is shown by isobars on Chart II, which also gives the so-called resultant wind direction, as explained on pages 365-367 of the REVIEW for December, 1893. The computation of these resultants for January, 1894, is also given in a subsequent part of the present REVIEW. The pressures here charted are those shown by mercurial barometers uncorrected for the effect of the variations of gravity with latitude. This correction is shown by the numbers printed on the border of Chart II; it should be applied and new isobars drawn by those engaged in special researches.

The normal distribution of atmospheric pressure and normal resultant wind direction for the month of January were approximately shown on Chart VIII of the REVIEW for January, 1893, as computed by Prof. H. A. Hazen, and are not now reproduced.

As compared with the normal for January, the mean pressure for the current month was deficient throughout the in-

terior of the country, but in excess over California and on the Atlantic coast. The line of no departure passes through Sault Ste. Marie and Grand Haven, Mich., Cincinnati, Ohio, central Kentucky, western Tennessee, Montgomery and Mobile, Ala., central Louisiana, and southward into the Gulf; it reappears in central Texas, passes northward along the one hundred and ninth meridian, westward on the forty-second parallel, southwest to central Nevada, northwest to Eureka, Cal., and the Pacific coast. The greatest excess of pressure was 0.09 in central New England, Maine, and the Maritime Provinces; 0.05 at San Francisco and Los Angeles, Cal. The greatest deficiencies were 0.18 at Calgary, Alberta, 0.13 at Medicine Hat, Assiniboia, and 0.11 at Tatoosh Island, Wash.

As compared with the preceding month of December, 1893, the mean pressure for January, 1894, has fallen decidedly in Washington and Oregon, but risen in Nova Scotia, New England, and the St. Lawrence Valley. The line of no change enters California at San Francisco, and passes out between Yuma and San Diego; it also passes from central Alberta southeast to central Nebraska and thence to the center of

Lake Michigan, the southern edge of Lake Erie, through central West Virginia and Virginia, eastward to the Atlantic. The larger falls in pressure were 0.14 or 0.15 on the coast of Oregon and Washington; 0.08 or 0.09 in Texas, Louisiana, and Arkansas; a decided fall also occurred in Manitoba. The larger increases of pressure have been 0.06 at Edmonton, Alberta, and Swift Current, Assiniboia; also at Northfield, Vt., Montreal and Quebec, Quebec, Halifax, N. S., and Portland, Me., and 0.07 at Eastport, Me., and Chatham, N. B.

The periodic diurnal variations of local pressure are shown by the hourly means given in Table VI, of meteorological data, on a subsequent page.

#### PATHS OF HIGH AND LOW AREAS.

The paths pursued by centers of high and low pressure during January, 1894, are shown on Charts Nos. IV and I, respectively, and the duration and velocity are given in the table at the end of this chapter. The charts show by small circles the positions of the centers. Within the circles are given the pressures reported nearest the centers and the corresponding dates. If a decided trough of low pressure or ridge of high pressure exists at that time its location is shown by a short wavy line through the center. Sometimes distant centers are connected by such ridges or troughs, but in such the middle portion of the wavy line is omitted in order to avoid confusing the map.

#### HIGH AREAS.

I.—On the 1st, a. m., pressure was highest in West Virginia and western Tennessee; this area moved slowly eastward as a ridge extending northeast and southwest, while areas of low pressure developed on its northwest and southeast sides.

II.—On the 1st, p. m., pressure was rising in Alberta, and a small area of high pressure moved southeastward, disappearing on the 4th in the Missouri Valley as the southeastern end of a ridge in connection with high area No. V.

III.—On the 2d, p. m., pressure had risen west of Oregon and British Columbia; this rise extended southward, and on the 3d, p. m., was west of northern California, while low area No. IV was central in Alberta and Saskatchewan.

IV.—On the 4th, a. m., pressure was apparently rising north of Lake Superior, with cold, northerly winds in the rear of low area No. II; the exact location of the center can not be given, but its general path was southeast until it disappeared on the 6th, p. m., over New Brunswick.

V.—On the 4th, p. m., an area of high pressure was advancing southeastward as a ridge, whose center was over Alberta; this extended by the 6th, a. m. into a large area of high pressure, whose center was then in northern Utah and Nevada. On the 5th, p. m., two centers had been located in Oregon and Wyoming, respectively, forming a ridge extending east and west, but these had again combined on the morning of the 6th in northern Utah and Nevada, and very low temperatures prevailed in California. This ridge slowly extended southward and again subdivided into areas *Va* and *Vb*, which were central on the morning of the 7th in California and New Mexico, respectively; they had disappeared on the morning of the 8th, although pressure remained generally high throughout the Pacific coast and Rocky Mountain regions, and the high pressure attending area No. V became the southern part of the still higher pressure, No. VI, since no trough of low pressure developed between them.

VI.—On the 6th, a. m., pressure was rising in Saskatchewan and Assiniboia and by the 7th, a. m., was highest in North Dakota; here the ridge divided into two parts, *VIa* and *VIb*. A slight trough developed on the southwest side from Washington to Wyoming, but had filled up by the morning of the 8th, when the highest pressure was in Alberta, and a ridge extended thence southeast to West Virginia, where high pressure area No. *VIb* was then central. The principal high

area, No. *VIa*, moved southeastward on the 8th to the northern border of Montana, after which it divided into two portions, the main branch, *VIa*, moved southwest into Utah, where it was central on the 9th, a. m., and a minor center, *VIc*, moved southeast into Nebraska, whence it moved northeast and joined high area No. VIII. The Utah area moved slowly southward, maintaining a high pressure over the central and southern Rocky Mountain plateau; on the 11th, p. m., it was still central in Utah, while another branch, No. *VI d*, had moved off to the east and was then central in Indian Territory. The high area, No. *VIa*, continued to prevail over the central and southern Rocky Mountain plateau until the 13th, and disappeared on the 15th, a. m., in Arizona, but reappeared in California on the 16th, p. m., after which it moved steadily east-northeast to Lake Superior, where it joined high area No. VIII. The branch, No. *VI d*, moved eastward through Arkansas and Tennessee and disappeared on the 14th, a. m., off the coast of Georgia. It thus happened that from the 6th to the 14th high pressure and clear weather prevailed over the Rocky Mountain region and the Southwest.

VII.—On the 15th, a. m., an area of high pressure was apparently advancing southeastward over Manitoba. The center of this area moved eastward beyond the northern limit of our stations, where cold, northerly winds and high pressure prevailed. It passed over the mouth of the St. Lawrence on the 17th, and descending southward disappeared on the 18th on the coast of Nova Scotia as a long ridge extending southwest to Georgia, where pressure was highest on the 18th, p. m. This latter center is numbered *VIIa*, since it owed its existence more to the outflow from high area No. VII than to the flow of air from other regions into the trough containing low area No. XIII.

VIII.—On the 17th, p. m., pressure was rising in Saskatchewan, with low temperatures, while high area No. *VIa* was central in Utah, and low areas prevailed on the west in British Columbia and on the east over Lake Superior. High area No. VIII moved southeast to Lake Superior, where it was central on the 19th, a. m., and high area No. *VIa* moved northeast to Lake Superior, where the two joined on that date, they having in the meantime contributed largely to the development of low area No. XIII which adjoined them on the east.

IX.—On the 18th, a. m., pressure began rising in northern Alberta, while low pressure prevailed in British Columbia. The highest pressure, at Edmonton, Alberta, occurred on the 19th, a. m., after which it fell and again rose on the 20th, with very low temperatures.

X.—Pressure rose on the 18th west of California and on the morning of the 19th was highest at San Francisco. On the 19th, p. m., high pressure prevailed over the central and southern plateaus and California, while low area No. XVI was central on the coast of British Columbia. Pressure again fell on the 20th as the high center moved south and east into Arizona, where it disappeared.

XI.—On the 20th, p. m., pressure had risen decidedly, with low temperatures, in northern Alberta. Pressure steadily increased during the 21st and 22d, the maximum reported being 31.24, with temperature of  $-30$  at Calgary on the 23d, a. m., (a still higher report on the 23d, p. m., is supposed to be a telegraphic error). This remarkable high central pressure was not preceded by any notable fall of pressure in any portion of our Daily Weather Map, but low pressure prevailed on the 19th, p. m., from Washington northward and westward, and an extensive storm may have existed on the Pacific coast of southern Alaska; at this same time low area No. XVI was passing northeastward over the upper Lake region. The area of high pressure evidently represented the banking up of cold descending air which reached the earth's surface on the northeast slope of the Rocky Mountains in Athabasca, Alberta, and Saskatchewan, and thence spread in all directions, principally

southeastward. The steep barometric and thermal gradients toward the southwest on the 20th, 21st, and 22d represent the effort to push over the Rocky Mountains, while the northwest winds of Assiniboia, Montana, and the Dakotas represent the resulting flow of the air toward the southeast. The extensive cold wave that attended this flow of air was modified by the fact that moderately high pressures were already prevailing over the greater portion of the United States.

The line of freezing temperatures on the morning map of the 21st extended from northern Oklahoma northeast to Sault Ste. Marie, Mich.; on the 22d from southern Oklahoma to Lake Ontario; and on the 23d from southern Oklahoma to Massachusetts; therefore, its southeastward movement had been very slow up to that time, but during the 23d the cold wave swept rapidly southward, and on the morning of the 24th freezing temperatures prevailed over the whole of Texas, and the isotherm of  $32^{\circ}$  passed from Galveston to central Tennessee, Detroit, Mich., and just north of lakes Erie and Ontario, so that the area above freezing was pushed northward over New York while it was pushed southward beyond Texas. By the morning of the 25th the area of temperatures below  $32^{\circ}$  had pushed eastward over the greater part of the Atlantic and Gulf States and southward into the western portion of the Gulf of Mexico, where a severe norther prevailed. Cold northerly gales began at Corpus Christi and Galveston, Tex., and New Orleans and Port Eads, La. The norther must have reached Vera Cruz by the morning of the 25th, but no reports have yet been received from that region. The technical cold wave, viz., a fall of  $20^{\circ}$  within 24 hours and to temperatures of  $40^{\circ}$  and below, will be found described under "Cold Waves." The center of high area No. XI passed from Alberta on the 23d, a. m., southeast to Nebraska on the 23d, p. m., thence south into Kansas on the 24th, a. m., after which it turned northeast as usual and disappeared on the 27th, a. m., in Newfoundland, where the pressure at that time was 30.64 at St. Johns.

XII.—On the 24th, a. m., pressure again began rising in Alberta and Saskatchewan, while it was falling on the western slope of the Rocky Mountains, and an area of high pressure passed eastward over Manitoba on the 25th and 26th, after which it stretched southward and disappeared on the 28th as a small area on the middle Atlantic coast.

XIII.—On the 27th, a. m., pressure had risen over the middle Rocky Mountain plateau region, while slight depressions prevailed to the north and south; this area maintained that position during the 28th, but on the morning of the 29th the highest pressure had moved southeastward into Texas, after which it moved eastward over the Gulf and disappeared on the 31st east of Florida.

#### LOW AREAS.

I.—This appeared off the coast of British Columbia on the 1st, a. m., and by 1st, p. m., a trough had developed, covering Washington, Wyoming, and Minnesota; low areas Nos. I, II, and III were central in those States, while high pressure prevailed north and south of this trough. Low area No. I then filled up and disappeared.

II.—This was central in Montana on the 1st, a. m., moved southeast into Iowa, thence northeast over the Lake region, expanding, on the 3d, into a trough stretching northeast and southwest; on the 4th it moved rapidly and disappeared over the Gulf of St. Lawrence.

III.—This depression constituted the eastern end of a trough of low pressure on the 1st, p. m., but rapidly disappeared by merging into low area No. II.

IV.—A decided low area appeared on the 3d, a. m., in Alberta; it disappeared probably by moving northeast beyond our stations by the 4th, a. m. At this time an independent centre, No. IVa, was developing in Indian Territory,

which passed northeastward and disappeared on the 5th, p. m., off the coast of New England.

V.—A slight depression moved over the southern plateau region between the 4th, p. m., and the 5th, a. m.; by the 6th, a. m., it had moved from Texas to Indiana, and a slight depression prevailed over a large region. By the 7th, a. m., a new center, No. VII, had developed in Virginia and North Carolina, while the original had disappeared in Canada.

VI.—A slight depression existed in the west Gulf States on the 5th, a. m., and by 8 p. m. of that date had merged with low area No. V.

VII.—This area developed on the 6th and 7th off the middle Atlantic coast; it was of a very indefinite nature at that time, but by the morning of the 8th had developed into a well-marked storm center south of Newfoundland.

VIII.—This area appeared as a slight depression between opposing winds in southern Texas on the 6th, a. m.; it retained the characteristics of a long trough until the 7th, a. m., when it was central in North Carolina. The southern end of this trough filled up and the northern end developed into low area No. VII.

IX.—A low area appeared off the coast of Washington on the 6th, a. m., and continued, until the 7th, a. m., to expand southeastward as a trough into Idaho, after which it filled up in the presence of high areas on its northeast and southwest sides.

X.—A slight depression appeared on the 8th, p. m., in western Kansas. By the 9th, a. m., this had moved into northeastern Texas, and by the 9th, p. m., a large area of relatively low pressure prevailed from the Lake region southward to the Gulf. This expanded into an indefinite depression whose center remained in the Gulf States during the 10th, and was in North Carolina on the 11th, a. m., after which it disappeared.

XI.—During the 8th a low area moved southeastward over Alberta, and on the 9th, a. m., the center was in that province; it moved southeast and on the 11th, a. m., was central north of Lake Huron, with westerly gales over the Lake region. On the 11th, p. m., it crossed the St. Lawrence between Montreal and Quebec, and on the 12th, a. m., was central in southwest Nova Scotia, with northwest gales throughout New England, the Middle States, and the lower Lake region; an hour before the 8 a. m. report the barometer at Bermuda read 29.69, with westerly winds of force 6 and clear weather. On the 12th, p. m., the center was near and a little east of Halifax, where the barometer at that moment read 28.88. On the 13th, a. m., the center was a little east of Sidney, Cape Breton, where the pressure at that moment was 28.48, and northwest gales still continued on the coast of New England, with temperatures varying from zero at Eastport, Me., to  $22^{\circ}$  at New York, N. Y. On account of the low temperatures and high winds this storm was very severe; many vessels encased in ice became helpless. The schooner *Minnie C. Taylor* was wrecked near the Weather Bureau station at Nantucket, Mass. "The service rendered by our telephone wire to Great Point was invaluable on this occasion, as it enabled the life-saving crew to keep posted as to the movements of the schooner before she struck and to have a wrecking crew promptly at the spot and thus save a great part of the cargo."

XII.—On the 11th, a. m., a low area was moving southeastward into Alberta while low area No. XI was central between Huron and James Bay; pressure was at that time high over the Rocky Mountain plateau region and the boundary between the high and low pressure may be described as passing from Florida northwest to Manitoba and thence southwest to Oregon, consequently low areas Nos. XI and XII represent whirls on the northeast side of this large region of high pressure. By the 13th, a. m., low area No. XII had moved south-

east to Calgary, where pressure was then 28.94, while low area No. XI was central near Cape Breton, and a high area covered the southern half of the United States. As low area No. XII moved eastward, or possibly northeastward, its deep depression filled up and disappeared on the 15th, leaving a moderate and extensive area of depression extending from the lower Missouri Valley to James Bay, while a more decided depression extended from the same region northwest to Washington.

XIII.—Between the 13th, a. m., and 14th, a. m., pressure rose decidedly in Alberta, but fell on the Pacific coast, and a depression began to extend eastward into Montana; this was central on the 14th, a. m., some distance to the west of the coast; on the 14th, p. m., near Tatoosh Island, Wash.; and on the 15th, a. m., in Montana. This trough moved northward, and on the 15th, p. m., extended from Vancouver Island eastward to Assiniboia. On the 16th, a. m., the principal center was in southern Montana, and p. m., in southern Dakota; 17th, a. m., in Iowa, and p. m., over Lake Superior; 18th, a. m., over Lake Huron, with warm southerly gales over the lower lakes. The center then moved rapidly northeast and disappeared over Labrador on the 19th.

XIV.—An indefinite depression, with rain, prevailed over the lower lake region on the 15th, a. m., and by the 16th, a. m., the center was southeast of the New England coast, after which it disappeared.

XV.—By the 19th, a. m., the barometer had fallen in Colorado, New Mexico, western Nebraska, Kansas, and Texas, while it had risen in California. From this condition a low area resulted whose center was near the boundary of Colorado and Texas on the 19th, a. m. This depression rapidly developed in that region, and on the 28th, a. m., was central in northern Iowa as a general storm; high southerly winds, with rain, prevailed from Texas to the Lake region and northerly winds, with snow, from Lake Superior and Manitoba to southern Minnesota. On the 20th, p. m., the center was near Lake Superior, with a general increase in the winds and the extent of rain and snow area; after this it moved northeastward and disappeared over Labrador on the 22d, a. m.

XVI.—On the 19th, a. m., pressure began to fall on the coast of Oregon and British Columbia, and by the 19th, p. m., the low center was probably inside of Vancouver Island. Like its predecessors this depression soon became a long trough which, on the 20th, a. m., extended southeast over Montana and made connection with low area No. XV that was at that time central in Iowa, so that the morning map showed the highest pressures in New England, Arizona, and Alberta or Saskatchewan, while the low pressure area extended from Texas northward to Lake Superior, and from Iowa northwest to Vancouver Island.

XVII.—From the 21st, a. m., to the 22d, a. m., pressure generally fell somewhat over the southern Rocky Mountain plateau and adjacent regions; the appearance of the remarkable high area, No. XI, extending from Alberta southeastward along the northeast slope of the Rocky Mountains argues the contemporaneous existence of the extensive low area to the southward. No center can be assigned to this area of low pressure, as it was undoubtedly an extension northward of the equatorial depression on the Pacific Ocean and the west coast of Mexico. On the 22d, p. m., the northwest end of this trough had reached Yuma, Ariz., where the pressure was then 29.88, and the trough of 29.90, or less, undoubtedly extended southeastward over the Gulf of California; at the same time cold northerly winds, with high pressure, were advancing rapidly southward over Nebraska and Kansas into Texas, and a rather high pressure, with northwest winds, also prevailed in northern California. These conditions were not favorable to the formation of a whirl north of the Mexican border or west of the Mexican plateau, and in the absence of reports from Mexico we can not state from observation what occurred in

that region, but on the 23d, a. m., there was evidently a small whirl and barometric depression on the southern border of Texas in a location where topographic conditions were favorable to its further development.

This was followed by an immediate increase of cold northerly winds over Texas and a heavy norther on the coast, which was followed, as usual, by the breaking up of whirls to the westward of the norther and the formation of new and more important whirls, or storm centers, to the south and east. High area No. XVII, therefore, disappeared after the 23d, p. m., and in its place a trough developed reaching from Louisiana to Lake Huron, and over the latter region low area No. XVIII was located on the 24th, a. m. This center was between Montreal and Quebec on the 24th, p. m., and westerly gales prevailed over the lower lake region. On the 25th, a. m., the center was apparently in Labrador, where it disappeared.

XIX.—The eastward movement on the 25th of the high area just alluded to may have been accelerated by the presence of a general depression in the West Indian region; its northerly winds reached Cape Hatteras, N. C., by the 25th, a. m., and Florida and Key West on the 25th, p. m.; this was of course followed by rain at all south Atlantic stations, and a special area of low pressure appeared east of Florida on the 26th, a. m. The center was east of North Carolina on the 26th, p. m.; south of Cape Cod, Mass., on the 27th, a. m.; and east of Halifax, N. S., on the 27th, p. m., after which it disappeared from our map.

XX.—On the 26th, a. m., the pressure was falling in northern Alberta, and by the 27th, a. m., a trough of low pressure was central in that region, while at the same time the pressure was higher on the southwest than on the northeast side of the trough. This trough extended southeastward over the Dakotas; its northwestern extremity filled up, and on the 28th, a. m., a depression was central near Yankton, S. Dak. The depression moved eastward over Iowa and Lake Michigan, where it was central on the 29th, a. m. Meanwhile another low area, No. XXI, had moved southeastward along the south Atlantic coast, and during the 29th the latter developed into an important storm then central near Baltimore, Md., while low area No. XIX as rapidly diminished in importance and on the 29th, p. m., appeared only as a relatively small depression in Michigan on the northwestern boundary of the whirl attending low area No. XXI. It disappeared on that date.

XXI.—The maps of the 27th, a. m. and p. m., showed a high pressure central on the Rocky Mountain plateau region, with northerly winds flowing to Mexico; the barometer had fallen in southern Texas, with northeast winds and rain; evidently a whirl, with low pressure, was developing on the Mexican border. This center probably moved slightly southeastward and then turned northeastward over the central portion of the Gulf of Mexico; it passed over northern Florida after the 28th, p. m., at which time a high barometer was central in southern New England, and northeast winds and rain were prevailing on the south Atlantic coast. Having reached this coast the depression was now in condition favorable for rapid growth, and its development was antagonistic to the development of low area No. XX, which was then in Iowa. A southern area of low pressure and cyclonic whirl generally absorbs its northern neighbor. On the 29th, p. m., it was central at the head of Chesapeake Bay, while northeast gales, with rain or snow, prevailed on the New England coast and temperatures of from 30° to 40°. On the 30th, a. m., the low pressure was central a little to the east of Boston, Mass., where the barometer read 28.78; westerly gales were then prevailing over New York, Connecticut, Cape Cod, Mass., and southward to Cape Hatteras, N. C.; easterly gales prevailed over Maine, the St. Lawrence Valley, the Canadian

Maritime Provinces, the Gulf of St. Lawrence, and Newfoundland. On the 30th, p. m., the storm center was in the Bay of Fundy, and pressure at Eastport, Me., was 28.78. On the 31st, a. m., the storm center was between Cape Breton and Newfoundland, and the pressure at Sidney was 28.88.

XXII.—On the 29th, a. m., low pressure was central near Vancouver Island; this extended rapidly inward as a slight and widely-diffused depression, and on the 30th, a. m., the lowest pressure was in Kansas and Colorado, and by the 30th, p. m., it had moved southward, stretching from New Mexico to Missouri, and by the 31st, a. m., still farther southward, extending from northern Texas to the lower Ohio Valley. By the 31st, p. m., this had become a trough reaching from southern Texas to West Virginia, dividing the regions of cold northerly and warm southerly winds; the steepest thermal gradients were a little to the north and parallel to the trough of lowest pressure.

XXIII.—This depression appeared in Alberta on the 31st, p. m.; its further history belongs to the REVIEW for February.

#### MOVEMENTS OF CENTERS OF AREAS OF HIGH AND LOW PRESSURE.

The following table shows the date and location of the beginning and ending of each center of high or low pressure that has appeared on the U. S. Weather Maps during the month, together with the average daily and hourly velocities for the month. These averages will differ accordingly as we consider each path as a distinct unit, or give equal weight to each hour of observation. The great variability in the rate of motion of these centers in different parts of the same path, or in different portions of the month, or over different portions of the regions covered by the Weather Map, points to the conclusion that the movement is largely influenced by general combinations of motions in the upper portion of the atmosphere, viz., above 5,000 or 10,000, but probably below 20,000 or 30,000 feet. The convection due to the heating and evaporation at the earth's surface does not easily permeate a still atmosphere to any great height, and we can not look to this convection in and of itself, as the exclusive cause or maintainer of extensive storms; on the other hand when the air is once in motion and by pushing over hills and mountains is forced up to considerable heights then the convection thus brought about will, if it intensifies the convection due to heat and moisture, produce conditions favorable to the formation of clouds and rain and the growth of any whirlwind, provided the whirling motion be, in the Northern Hemisphere, cyclonic, so as to be further favored by the action of the centrifugal forces on the revolving globe. If, however, the whirl be in the opposite direction, or if the conformation of the earth's surface be such as to oppose the convection due to heat (as, for instance, when the winds are descending a long slope instead of ascending) then the initial whirlwind is more likely to be annulled, or dissipated by the opposing forces.

During the month of January quite a number of areas of high pressure and low pressure have alike been apparently annulled in this manner while comparatively few have been started under such favorable conditions as to allow of their growth and continued existence for several days. The apparent division of some of these high areas into several portions and the apparent perpetuity of high area No. VIa for ten days in the neighborhood of Utah are all undoubtedly due, in part, to the crudeness of the assumptions that underlie all methods of reducing plateau and mountain stations to sea level.

#### Movements of centers of areas of high and low pressure.

Number.	First observed.			Last observed.			Path.		Average velocities.	
	Date.	Lat. N.	Long. W.	Date.	Lat. N.	Long. W.	Length.	Duration.	Daily.	Hourly.
<b>High areas.</b>										
I.	1, a. m.	29	99	3, p. m.	33	79	1,950	2.5	750	32
II.	1, p. m.	54	112	4, a. m.	40	100	800	2.5	320	13
III.	2, p. m.	124	87	3, p. m.	41	125	800	1.0	800	33
IV.	4, a. m.	53	87	6, p. m.	48	66	1,150	2.5	460	19
Va.	4, p. m.	115	8, a. m.	45	126	2,400	3.5	686	29	
Vb.	4, p. m.	53	115	8, a. m.	32	105	2,100	3.5	600	25
VI.	6, a. m.	59	104	7, a. m.	47	104	450	1.0	450	19
VIa.	7, a. m.	104	104	21, a. m.	48	59	7,200	14.0	514	21
VIb.	7, p. m.	47	104	11, a. m.	48	59	2,700	3.5	771	32
VII.	8, p. m.	49	104	9, a. m.	42	101	450	0.5	450	29
VIIa.	11, a. m.	39	111	14, a. m.	32	77	2,100	3.0	700	29
VIIb.	15, a. m.	52	98	18, a. m.	44	83	1,950	3.0	650	27
VIII.	18, p. m.	35	81	19, a. m.	33	83	200	0.5	200	27
VIIIa.	17, p. m.	54	106	21, a. m.	47	59	2,250	3.5	643	27
IX.	18, a. m.	54	117	19, p. m.	53	108	450	1.5	300	13
X.	18, p. m.	39	125	20, p. m.	34	110	1,000	2.0	500	21
XI.	20, p. m.	54	120	20, p. m.	46	58	4,000	6.0	667	28
XII.	24, p. m.	55	107	25, p. m.	40	73	2,100	4.0	525	22
XIII.	27, a. m.	42	109	31, p. m.	26	80	2,400	3.5	686	29
Sums							36,450	61.5	10,052	.....
Mean of 17 paths									591	24.6
Mean of 61.5 days									594	25.7
<b>Low areas.</b>										
I.	1, a. m.	49	129	1, p. m.	47	120	400	0.5	.....	.....
II.	1, a. m.	48	108	4, p. m.	48	64	2,750	3.5	786	33
III.	1, p. m.	47	92	2, a. m.	47	86	250	0.5	.....	.....
IV.	3, a. m.	54	114	3, p. m.	55	109	100	0.5	.....	.....
V.	4, p. m.	39	115	6, p. m.	46	84	2,100	2.0	1,050	44
VI.	5, a. m.	31	94	5, p. m.	34	95	250	0.5	.....	.....
VII.	6, p. m.	38	75	8, a. m.	40	57	1,100	1.5	733	31
VIII.	6, a. m.	28	98	7, a. m.	37	81	1,150	1.0	1,150	46
IX.	6, a. m.	48	126	7, p. m.	45	118	450	1.5	300	12
X.	8, p. m.	48	102	11, a. m.	35	78	1,550	2.5	620	26
XI.	9, a. m.	52	113	13, a. m.	47	59	2,700	4.0	675	28
XII.	11, a. m.	55	118	14, p. m.	55	91	1,000	3.5	457	19
XIII.	14, a. m.	48	128	18, p. m.	51	66	3,700	4.5	822	34
XIV.	15, p. m.	43	80	16, a. m.	41	69	600	0.5	.....	.....
XV.	19, a. m.	37	103	22, a. m.	53	64	2,200	3.0	733	30
XVI.	19, p. m.	55	125	20, a. m.	48	113	500	0.5	.....	.....
XVII.	22, p. m.	32	114	23, p. m.	26	99	1,000	1.0	1,000	42
XVIII.	24, a. m.	44	81	25, a. m.	51	60	1,050	1.0	1,050	42
XIX.	27, a. m.	51	77	27, p. m.	45	60	1,400	1.5	933	39
XX.	27, a. m.	33	118	29, p. m.	46	84	1,750	2.5	700	29
XXI.	27, p. m.	26	97	31, a. m.	47	60	2,700	3.5	771	32
XXII.	29, a. m.	49	126	31, p. m.	30	97	2,200	2.5	850	37
Sums							31,500	4.20	12,660	.....
Mean of 16 paths									791	33.0
Mean of 42.0 days									750	31.2

#### NORTH ATLANTIC METEOROLOGY.

[Pressure in inches and millimeters; wind-force by Beaufort scale.]

The normal pressure for January over the North Atlantic Ocean, as deduced from the international simultaneous observations, is highest, 30.20 (767), in a small area between the Azores and the Windward Islands; it is lowest, 29.50 (749), in a region between southern Greenland, Iceland, and Spitzbergen. As compared with December the normal pressure for January rises about 0.05 in the region southwest of the Azores, but falls in the extreme north Atlantic.

The average velocity of movement of storm centers during January is about 22 statute miles per hour, and at least two or three such storm centers can usually be traced across the

ocean from Labrador and Nova Scotia to Norway and France. During January about an equal number of storm centers seem to reach the Atlantic near Newfoundland from British Columbia, the Gulf States, and the south Atlantic coast, respectively, but in general all of these are whirls developed within long troughs of low pressure whenever such troughs come into locations favorable for such development. All these troughs in January appear as the eastern ends of branches from either the north Pacific depression or the equatorial Pacific depression; the former stretches southeastward into Washington whenever a storm center moves northeastward toward southern